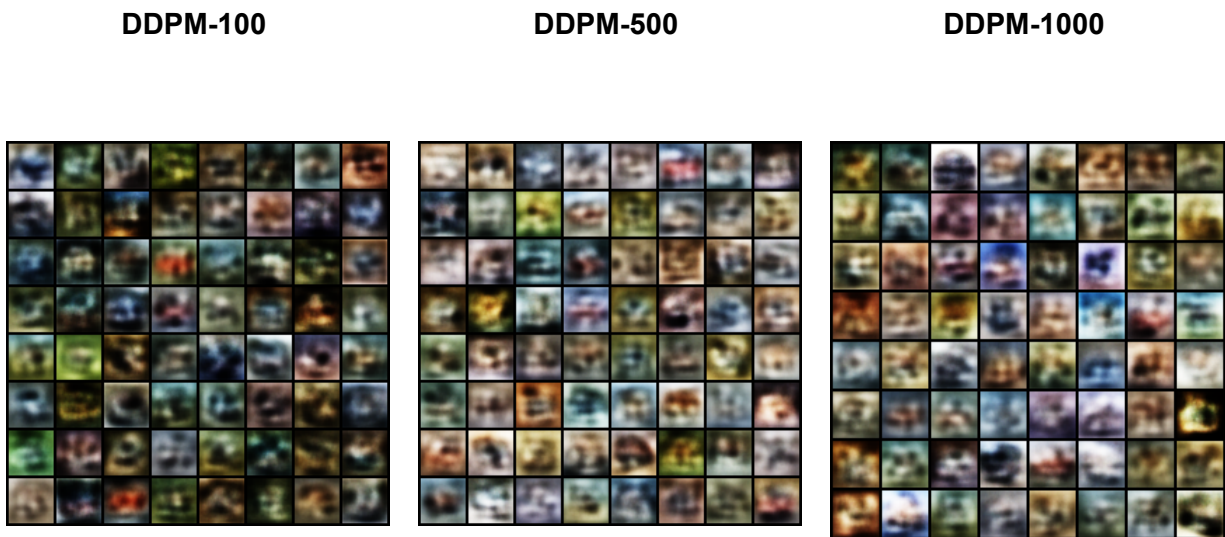# Assignment 9: Diffusion and Flow Matching on CIFAR-10

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## 1. Generated Image Samples

### DDPM Samples (Latent Space)

**Figure 1: DDPM Generated Samples - All Variants**

| DDPM-100 | DDPM-500 | DDPM-1000 |
|:---:|:---:|:---:|



### Flow Matching Samples (Image Space)

**Figure 2: Flow Matching Generated Samples - All Variants**

| FM-ODE-10 | FM-ODE-50 | FM-ODE-100 |
|:---:|:---:|:---:|

## Comparison Summary

### Figure 3: DDPM vs Flow Matching Comparison



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# 2. Diffusion Process Visualization

## Forward and Reverse Diffusion for 2 Sample Images

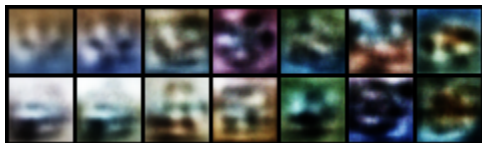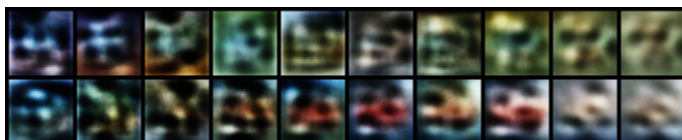### Figure 4: Forward Diffusion Process



### Figure 5: Reverse Diffusion Process

The forward process demonstrates how structured image information progressively degrades into Gaussian noise across timesteps. The reverse process shows the model's ability to iteratively denoise and recover meaningful image structure from pure noise.

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## 3. Performance Metrics

```
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       ASSIGNMENT 9 RESULTS TABLE
==========================================
Model Variant          | IS (Higher is better)   | FID (Lower is better)
DDPM-100               | 1.9059 (1.5-2.0)        | 208.36 (300-350)
DDPM-500               | 2.1355 (1.5-2.0)        | 204.86 (300-350)
DDPM-1000              | 2.0156 (1.5-2.0)        | 211.88 (300-350)
-----------------------------------------------------------------
FM-ODE-10              | 3.3403 (1.0-1.5)        | 135.08 (200-250)
FM-ODE-50              | 3.5449 (1.0-1.5)        | 123.75 (200-250)
FM-ODE-100             | 3.5551 (1.0-1.5)        | 127.83 (200-250)

Done! Check 'output_images' folder for visualizations.
```

**Notes:**

- Higher Inception Score indicates better image quality and diversity
- Lower FID Score indicates generated images are closer to real images
- All metrics calculated on 1000 test images from CIFAR-10 test subset
- DDPM models: trained with different diffusion timesteps (100, 500, 1000)
- Flow Matching models: same trained model, sampled with different ODE integration steps (10, 50, 100)